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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/573,239

03/22/2006

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EXAMINER

KIM, JAY C

ART UNIT

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/573,239	<b>Applicant(s)</b> MARTSINOVSKY ET AL.	
	<b>Examiner</b> JAY C. KIM	<b>Art Unit</b> 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.  
4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 March 2006 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☒ All b) ☐ Some \* c) ☐ None of:
- ☒ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. ____.                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>3/22/06, 4/19/06</u> .  | 6) <input type="checkbox"/> Other: ____.                          |

### **DETAILED ACTION**

This Office Action is in response to the Application filed March 22, 2006.

#### ***Drawings***

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the “emitter coated with a layer of a band gap material” recited in claim 1 must be shown or the feature canceled from the claim. No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Objections***

2. Claims 4 and 15 are objected to because of the following informalities: on line 1 of each claim, “band gap” should be inserted between “of” and “material”. Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claim 13 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The claim limitation “preventing back tunneling of electrons in a tunnel diode” fails to comply with the enablement requirement, because there is always a probability, however small, of back tunneling according to quantum mechanics.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claim 4 recites the limitation "said emitter" in the tunnel diode of claim 3. There is insufficient antecedent basis for this limitation in the claim.
7. Claims 7-9 and 18-20 recite the limitation "electrodes" in a tunnel diode. There is insufficient antecedent basis for this limitation in the claims.
8. Claims 12 and 14-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claim 12, it is unclear whether "the Fermi level" recited in claim 12 refers to the Fermi level of the emitter or the Fermi level of a portion of the collector. Claims 14-20 depend on claim 12, and therefore claims 14-20 are also indefinite.

***Claim Rejections - 35 USC § 102***

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. Claims 1-3, 5, 9-14, 16 and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Cox (US 6,064,137).

Regarding claims 1 and 5, Cox discloses a tunnel diode (Figs. 1g and 5) in which the collector (composite layer of 8 and 6) (col. 8, lines 27-28 and 30-31) comprises a band gap material (6), the band gap material being a crystal material having filled zero temperature valence band and empty conductive band, and in which the band gap material is a diamond material.

Regarding claim 2, Cox additionally comprises an emitter (composite layer of 4 and 6) (col. 8, lines 24-25) coated with a layer of a band gap material (6).

Regarding claim 3, Cox further discloses for the tunnel diode of claim 1 that the collector (composite layer of 8 and 6) comprises a layer of band gap material (6) deposited on a metal collector (8) (col. 10, line 44).

Regarding claim 9, Cox further discloses for the tunnel diode of claim 1 that a gap between an emitter and a collector electrodes (composite layer of 4 and 6, and composite layer of 8 and 6, respectively) is evacuated (col. 8, lines 54-55).

Regarding claim 10, Cox discloses a vacuum diode heat pump (Fig. 5) comprising the tunnel diode of claim 1 (col. 11, lines 24-29).

Regarding claim 11, Cox discloses a heat to electricity converter (Fig. 5) comprising the tunnel diode of claim 1 (col. 7, lines 54-55).

Regarding claims 12 and 16, Cox discloses a method for promoting the tunneling of electrons from an emitter surface (composite layer of 4 and 6 in Figs. 1g and 5) (col. 8, lines 24-25 and 30-31) comprising the step of positioning a collector (composite layer of 8 and 6) (col. 8, lines 27-28) comprising a band gap material (6), which is a diamond material, at a distance within the tunneling range of the electrons, which is inherent for

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the tunneling gap diode (Figs. 1g and 5) to operate, the band gap material (6) being a crystal material having filled zero temperature valence band and empty conductive band.

Regarding claim 13, Cox discloses a method for reducing back tunneling of electrons in a tunnel diode (Figs. 1g and 5) comprising the step of coating a collector (8) (col. 8, lines 27-28) with a layer of a band gap material (6) (col. 8, lines 30-31), the band gap material (6) being a crystal material having filled zero temperature valence band and empty conductive band.

Regarding claim 14, Cox further discloses for the method of claim 12 that the collector (composite layer of 8 and 6) comprises a layer of band gap material (6) deposited on a metal collector (8) (col. 10, line 44).

Regarding claim 20, Cox further discloses for the method of claim 12 that a gap between the emitter and collector electrodes (composite layer of 4 and 6, and composite layer of 8 and 6) is evacuated (col. 8, lines 54-55).

11. Claims 1, 3-6, 9-17 and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Bell (US 4,280,074).

Regarding claims 1, 5 and 6, Bell discloses a tunnel diode (Figs. 2 and 8) in which the collector (Fig. 2 and 36 in Fig. 8) (col. 4, line 54) comprises a band gap material (composite layer of 25-27) (col. 3, lines 56-62), the band gap material (composite layer of 25-27) being a crystal material having filled zero temperature

valence band and empty conductive band, and in which the band gap material (composite layer of 25-27) is a semiconductor such as GaAs (col. 4, lines 60-62).

Regarding claim 3, Bell further discloses that the collector (Fig. 2 and 36 in Fig. 8) comprises a layer of band gap material (composite layer of 25-27) deposited on a metal collector (28 in Fig. 2).

Regarding claim 4, Bell further discloses that the layer of band gap material (composite layer of 25-27) has a thickness (col. 4, lines 62-63) greater than the mean distance of relaxation of electrons tunneling from an emitter (35) (col. 4, line 59), which is ~ 10 nm or more (current Application, line 37 of page 2 - line 1 of page 3).

Regarding claim 9, Bell further discloses for the tunnel diode of claim 1 that a gap between the emitter and collector electrodes (35 and 36, respectively) is evacuated (col. 4, lines 58-59).

Regarding claim 10, Bell discloses a vacuum diode heat pump (Fig. 8) comprising the tunnel diode of claim 1, because heat is transferred from the heat source (37) to the heat sink (38) by electron emission from the emitter (35).

Regarding claim 11, Bell discloses a heat to electricity converter (Fig. 8) comprising the tunnel diode of claim 1, because electrons are emitted from the emitter (35) in contact with the heat source (37).

Regarding claims 12, 16 and 17, Bell discloses a method for promoting the tunneling of electrons from an emitter surface (35 in Fig. 8) (col. 4, line 59) comprising the step of positioning a collector (Fig. 2 and 36 in Fig. 8) (col. 4, line 54) comprising a band gap material (composite layer of 25-27) (col. 3, lines 56-62) at a distance within



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the tunneling range of the electrons, which is inherent for the tunneling gap diode (Figs. 2 and 8) to operate, the band gap material (composite layer of 25-27) being a crystal material having filled zero temperature valence band and empty conductive band, and in which the band gap material (composite layer of 25-27) is a semiconductor such as GaAs (col. 4, lines 60-62).

Regarding claim 13, Bell discloses a method for reducing back tunneling of electrons in a tunnel diode (Figs. 2 and 8) comprising the step of coating a collector (28 in Fig. 2) (col. 3, lines 55-56 and 62) with a layer of a band gap material (composite layer of 25-27) (col. 3, lines 56-62), the band gap material (composite layer of 25-27) being a crystal material having filled zero temperature valence band and empty conductive band.

Regarding claim 14, Bell further discloses for the method of claim 12 that the collector (Fig. 2 and 36 in Fig. 8) comprises a layer of band gap material (composite layer of 25-27) deposited on a metal collector (28).

Regarding claim 15, Bell further discloses that the layer of band gap material (composite layer of 25-27) has a thickness (col. 4, lines 62-63) greater than the mean distance of relaxation of electrons tunneling from the emitter (35), which is ~ 10 nm or more (current Application, line 37 of page 2 - line 1 of page 3).

Regarding claim 20, Bell further discloses for the method of claim 12 that a gap between the emitter and collector electrodes (35 and 36, respectively) is evacuated (col. 4, lines 58-59).

***Claim Rejections - 35 USC § 103***

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. Claims 7, 8, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cox (US 6,064,137) in view of Tavkhelidze et al. (US 6,417,060). The teachings of Cox et al. are discussed above.

Regarding claims 7, 8, 18 and 19, Cox differs from the claimed invention by not showing that the electrodes are separated by a gap in the range 1-100nm (claims 7 and 18), and not showing that the electrodes are separated by a gap in the range 1-10nm (claims 8 and 19).

Tavkhelidze et al. disclose a tunnel diode (Fig. 2) comprising an emitter electrode (5) (col. 3, line 33) and a collector electrode (1) (col. 3, line 35), wherein the electrodes (5 and 1) are separated by a gap in the range 50 nm or less, preferably 5 nm or less (lines 9-12 of ABSTRACT).

Since both Cox and Tavkhelidze et al. teach a tunnel diode, it would have been obvious to the one of ordinary skill in the art at the time the invention was made that the electrodes disclosed by Cox may be separated by a gap in the range disclosed by Tavkhelidze et al., for example, ~ 5 nm, because the gap distance between the

electrodes in the tunnel diode can be varied to control electron tunneling and thus the performance of the tunnel diode.

Further regarding claim 7, 8, 18 and 19, the claims are prima facie obvious without showing that the claimed ranges of the gap distance achieve unexpected results relative to the prior art range. In re Woodruff, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also In re Huang, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and In re Aller, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

14. Claims 7, 8, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bell (US 4,280,074) in view of Tavkhelidze et al. (US 6,417,060). The teachings of Bell et al. are discussed above.

Regarding claims 7, 8, 18 and 19, Bell differs from the claimed invention by not showing that the electrodes are separated by a gap in the range 1-100nm (claims 7 and 18), and not showing that the electrodes are separated by a gap in the range 1-10nm (claims 8 and 19).

Tavkhelidze et al. disclose a tunnel diode (Fig. 2) comprising an emitter electrode (5) (col. 3, line 33) and a collector electrode (1) (col. 3, line 35), wherein the electrodes

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(5 and 1) are separated by a gap in the range 50 nm or less, preferably 5 nm or less (lines 9-12 of ABSTRACT).

Since both Bell and Tavkhelidze et al. teach a tunnel diode, it would have been obvious to the one of ordinary skill in the art at the time the invention was made that the electrodes disclosed by Bell may be separated by a gap in the range disclosed by Tavkhelidze et al., for example, ~ 5 nm, because the gap distance between the electrodes in the tunnel diode can be varied to control electron tunneling and thus the performance of the tunnel diode.

Further regarding claim 7, 8, 18 and 19, the claims are prima facie obvious without showing that the claimed ranges of the gap distance achieve unexpected results relative to the prior art range. In re Woodruff, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also In re Huang, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and In re Aller, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

### ***Double Patenting***

15. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory

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obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

16. Claims 1-20 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-9 and 11-15 of copending Application No. 11/392,182. Although the conflicting claims are not identical, they are not patentably distinct from each other because claims 1-9 and 11-15 of Application No. 11/392,182 include all the recited limitations of claims 1-20 of current Application.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAY C. KIM whose telephone number is (571)270-1620.

The examiner can normally be reached on 7:30 AM - 5:00 PM EST.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew C. Landau/  
Primary Examiner, Art Unit 2815

/J. K./  
Examiner, Art Unit 2815

March 14, 2008